Space Weather Technical Forecast

Issued on Tuesday, 30 November 2021 at 12:19 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Increased chance (30%) for G1/Minor Storm activity day 3 and perhaps day 4.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Very Low, with all X-ray flare activity below C-class. There are currently five numbered sunspot regions on the visible disc. AR2898 and AR2900 are both located in the southwest quadrant. The larger and more complex spot is AR2900, this has shown some slight decay in recent imagery. AR2898 remains relatively unchanged. AR2901 in the northeast remains a small, simple spot. Newly numbered AR2903 in the southeast quadrant is a small bi-polar group. The other newly numbered group, AR2902, in the northern hemisphere near centre disc, emerged quickly before steadying in growth, and is now showing some signs of decay. This is currently assessed as a Cri/Beta type.

There are a number of filaments on the disc and one was observed lifting from the southern hemisphere, just east of the Meridian at around 29/0745 UTC. After analysis it may have a slight Earth-directed component, likely arriving on 2nd December. No other Earth-directed CMEs were evident in available imagery.

Solar Wind / Geomagnetic Activity: The solar wind speed measured by DSCOVR at L1, was at ambient levels, varying between 330-375 km/s, with a slight overall downward trend. Density was generally average 5-10 ppcc. The Interplanetary Magnetic Field (IMF) strength, Bt, was weak at 5nT or less. The north-south component of the field (Bz), was occasionally weakly negative, peak -3nT. The phi angle was negative (towards the Sun) until around 30/0400 UTC when it switched to positive (away from the Sun). Geomagnetic Activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) remained at background levels. High energy electron flux (greater than 2 MeV) as observed by GOES-16 was predominantly at background levels, with a diurnal peak of 214 pfu at 29/2015 UTC. The associated 24-hour integrated fluence remained well below the Active threshold (1e8 integrated pfu), on a largely flat trend, with 2.4e6 integrated pfu recorded at 30/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to remain predominantly Very Low, with a chance of C-class flares, primarily from AR2900. There is a very slightly above background (5%) chance of M-class flares.

Solar Wind / Geomagnetic Activity: A CME from a filament eruption early on the 26 Nov has been assessed as likely missing, but with low confidence, giving a small chance of some impact at Earth on day 1 (30th). Enhancements from various coronal hole fast winds are expected through the period, including CH26 on day 2 (1st), then CH27 likely on day 3 or during day 4 (2nd or 3rd). A filament eruption which left the Sun on the 29th may also bring a brief elevation to solar wind speeds during day 3 (2nd). Geomagnetic activity is expected to be mostly Quiet to

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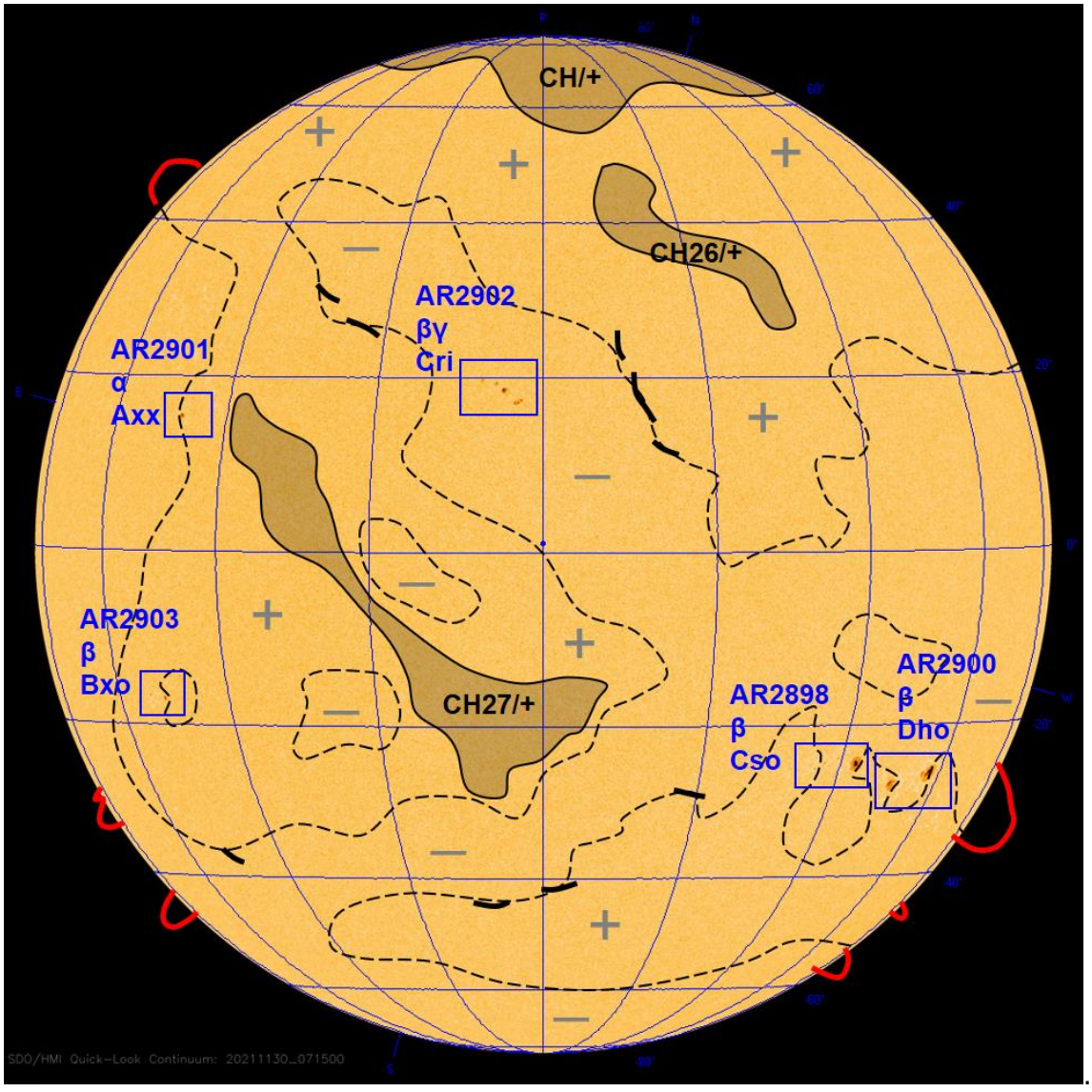
Unsettled, but with an ongoing chance of Active intervals. A very slight chance of G1/Minor Storms is maintained on days 1 and 2 (30th & 1st), but this increasing to a chance on days 3 and 4 (2nd & 3rd).

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at background levels. The high energy electron flux (greater than 2 MeV) is likely to be at background to moderate levels, with the next notable enhancement likely to be from the arrival of the faster winds from CH26 on day 2 (1st). If this occurs, the fluence may rise as a result, but it is currently expected to remain below the Active (1e8 integrated pfu) threshold.

Figure 1. Solar Analysis Valid 30/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A filament eruption was observed from the northeast disc around 26/0010 UTC, however analysis of any subsequent CME has been difficult due to limited good imagery. Whilst currently not expected, a glancing impact is possible during 30th November. A second filament eruption which left the Sun on the 29th may bring a brief elevation to solar wind speeds during 2nd December. There are no other Earth directed CMEs in the forecast.
The next possible coronal hole enhancement is likely 1st December from CH26/+, but this is likely to be brief and not expected to give significant impacts.

CH27/+ appears to be a more notable feature, and whilst its fast wind is not expected to arrive until 2nd or 3rd December, there is the potential for a very fast solar wind (near 700 km/s, which has been observed from some coronal holes in the southern disc during the last month). Enhanced observed solar winds from STEREO-A on 29th may also indicate potential faster solar winds from this feature reaching Earth on 2nd.

Consequently geomagnetic activity is expected to mostly Quiet, but with occasional Unsettled spells. There will be an ongoing chance of Active intervals on all days, due to the chance of coronal hole fast wind or CME arrivals. Days 1 and 2 will continue with a very slight chance of G1/Minor Storms, with this elevating to a chance during day 3 and 4 due to cumulative coronal hole and CME effects.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	5	30	30
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
29/1553	/	Filament eruption	South Centre Disc	570 km/s	02/1800 +/- 12hrs	Generally south directed but glancing blow possible.

Radio Blackouts - X-Ray Flares:

There are currently five numbered sunspot regions on the visible disc. AR2898 and AR2900 are

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both located in the southwest quadrant. The larger and more complex spot is AR2900, this has shown some slight decay in recent imagery. AR2898 remains relatively unchanged. AR2901 in the northeast remains a small, simple spot. Newly numbered AR2903 in the southeast quadrant is a small bi-polar group. The other newly numbered group, AR2902, in the northern hemisphere near centre disc, emerged quickly before steadying in growth, and is now showing some signs of decay. This is currently assessed as a Cri/Beta type.

Solar activity is likely to remain Very Low or Low, with a chance of C-class flares, most probably from region AR2900 in the southwest at present, with a very slight chance of an M-flare (5%).

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	5	5	5	5
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 is forecast to remain at background levels, with no solar radiation storms anticipated.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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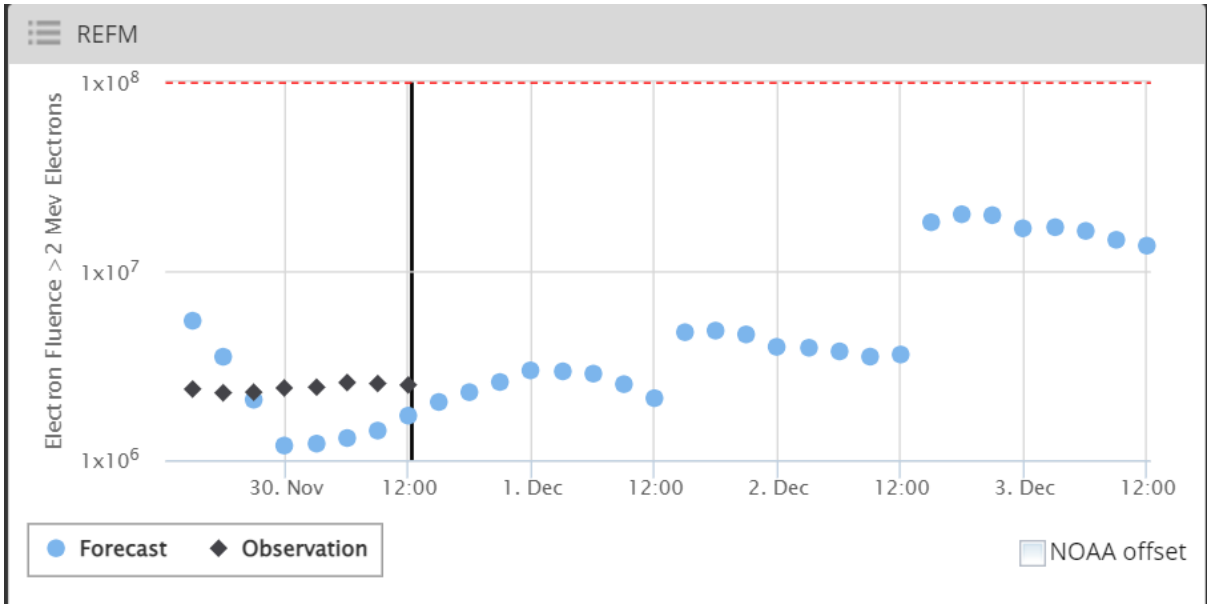
High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux as observed by GOES-16 at GEO has been at background to moderate levels during the last 24 hours, and is expected to continue at similar levels until a connection to a faster stream of solar wind occurs. The next potential enhancement is likely to be from the faster wind of CH26 on day 2 (1st), but more likely from potential connection with CH27 from day 3 (2nd) possibly increasing diurnal maximum levels to High by the end of the period, however confidence is low. Other enhancements to the solar wind on days 1-2 are currently not expected to lead to high flux levels being observed.

With flux likely to remain below the High level until later in the period, the associated 24 hour integrated fluence is expected to remain below the Active threshold, with only a slight chance of rising above at the end of the period. This is supported by REFM which maintains fluence levels at well below the Active threshold.

GEO Electron Environment	Level ($cm^{-2}\,sr^{-1}\,day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	1	5	10
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 2: MOSWOC REFM.



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